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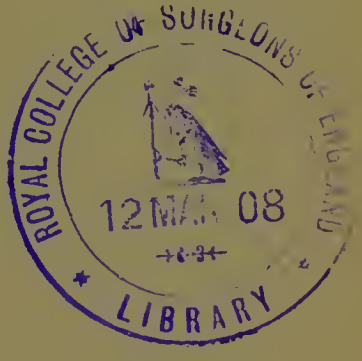

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The Hospital Unit.

BY GEORGE H. M. ROWE, M.D., MEDICAL SUPERINTENDENT, THE BOSTON CITY HOSPITAL.

THE motto of a famous scientist was, "Prove and prove again." This might well be the guiding idea of the hospital expert. Only long extended tests can vindicate what is best, either in method or result. The laboratory rule of "Observe, record, collate, conclude," applies to hospital construction as it does to most other lines of investigation.

The progress since the Civil War in building hospitals has given great impetus to broadening some of the general principles of their construction. Formerly they were not so often or so well constructed, because there were fewer standards. Medical science grew slowly, and naturally hospitals had a parallel development. Since the advent of aseptic surgery new principles have been evolved, revolutionizing old tenets and throwing new light upon the fundamental laws of construction. Even in my own time I have seen these principles pass through three stages: first, a "heap of buildings" full of ornamentation, with extension of surface in every conceivable form, both outside and inside the walls; second, the assumption that a building for sick people must necessarily become so choked and impregnated with disease germs as to be surgically unclean and hence unfit for safe occupancy, and that inexpensive one-storied buildings should be erected, these to be destroyed and renewed every ten or twelve years. But the advent of aseptic surgery soon taught us that it was not the germs lodged in a building that brought disaster, but the want of surgical cleanliness in all the persons and things that had to do with the patient. This aseptic surgical period brought a departure from the one-story building to those with several stories;

but, recognizing new hospital principles, they combined every feature ingenuity could suggest for the cleanliness of buildings, as well as the absolute cleanliness of persons, instruments, beds, linen and utensils. This new point of view, together with the extended uses of steam, with electricity which permitted power to be transmitted where previously steam was impracticable, combined with new and well adapted building materials in the surgical sense, gradually evolved a better type which is now accepted as the present standard. The general arrangement of a hospital group, the various ends to be attained for the different kinds of work, have become better understood. It is now clearly appreciated that hospitals, like other architectural specialties, are a distinct class by themselves, and require a specific treatment quite different from other buildings.

In the previous articles that have appeared in The Brickbuilder certain general principles of hospital construction have been ably set forth, and I do not intend to rehearse what has been so well said. I shall attempt briefly to elaborate some of the fundamental needs of construction and to deduct from my own hospital experience some conclusions, the result of a somewhat extended hospital service.

I take it for granted that the pavilion system is now conceded to be the best type of hospital economy, and my suggestions apply to a hospital, say, of 250 to 500 or more beds. As a numeral represents the definite number of units that compose it, so a hospital is a composite of the wards it contains. By the word unit is implied the large room or ward of standard size devoted to one class or sex of patients treated in one group, with the necessary accessories for the proper treatment of that group.

A hospital of any class or size, to be successful in its work, must in every case conform to at least three well-recognized curative agents:

First, plenty of sunlight. Each year of my experience emphasizes the importance of this factor. The architect should study and restudy his problem, "prove and prove again," keeping this as the first and greatest principle to which he must adhere; and just in proportion as he departs from it will his building be a failure.

Second, every part of a hospital, so far as possible, and especially all rooms in which the sick are treated, should have a plentiful and assured supply of *pure air* of standardized quantity, temperature and humidity. Most architects expend more labor in the attempt to attain this well-recognized desideratum, and give to it more thought than to the question of sunlight.

Third, in the general arrangement of the building and in all the details, outside as well as inside, the greatest consideration should be given to the problem of how to promote and insure cleanliness. An exterior laden with architectural ornamentation may be pleasing to the eye, but may not conduce to cleanliness. So, also, all interior details must be tested by the ease with which they may be kept clean, every part being continuously free from whatsoever impairs the cleanliness of patients according to the highest standard, — the room they occupy, the air they breathe, the multifold things used for their recovery, and obviously also the most careful personal hygiene of doctors and nurses. A hospital so constructed that it cannot supply these three indispensable factors is a departure from the best type. To these three essentials, sunlight, pure air, cleanliness, we may well add a fourth, fireproof construction. History shows that all wooden hospitals are ultimately destroyed by fire, and sometimes, alas! their occupants are also consumed.

It being assumed that one ward may now be safely superimposed upon another, the inquiry arises how many wards and how many sick persons may safely be placed in one building. So many local restrictions obtain that

various types of buildings result. Economy in first cost tends to create three and four story buildings. Limited sites, insufficient means, cost of land, and many other complications in thickly settled sections tend to multiply stories, and we find in some large cities hospitals of five, seven and nine stories, and one hospital about to be built will venture to run up to eleven stories. Such plans take the risk of more or less danger, although a thorough adherence to the principles of asepsis lessens the possibilities of the danger formerly so fatal. But even if the dangers are diminished, the administration of buildings with many stories must be much more costly. Comparison of different hospitals is oftentimes difficult, because the conditions and details vary so much, especially in cities.

The writer believes that when reasonable opportunities exist, even in city locations, hospital buildings should be upon the pavilion plan, not over three stories for wards of twenty-eight or thirty patients each, with a lower floor available for purposes directly connected with the wards, but not for the continuous treatment of bed patients, thus making an aggregate of about ninety patients in each building. Any considerable excess of this number of patients under one roof approaches a danger line.

It is a well-attested experience that when too many sick persons are massed in one building the conditions operate against the very purpose for which a hospital exists, that is, the cure of the sick. It was observed during the Civil War that the wounded soldiers who were treated in temporary shelters showed the smallest mortality; those who occupied farmhouses or other permanent structures were next in the percentage of deaths; while it was in the large barracks purposely constructed for hospital use where the mortality was in many cases enormous. Crowd poisoning resulted in epidemics of

hospital gangrene, erysipelas, surgical sepsis, typhoid fever and a long list of other infections. History points out many hospitals, both military and civil, which have verified this experience.

Whether the building should be one, two, three or more stories, there is a standard justified by experience for the details of arrangement which ought to be found in every ward.

What should be the best width, length, height, square feet of floor space, cubic feet of air space, and other standards of construction in the hospital unit? The arrangement of wards should not only conform to the correct standard for the recovery of the sick, but economy of administration. Florence Nightingale in her "Notes on Hospitals," a book of paramount value to every hospital worker, points out that if the cost of nursing in a large hospital be capitalized, and if the total number of patients be divided into wards varying in number of patients in each ward, it would be found that if the hospital were divided into uniform wards containing nine patients each, the cost of nursing would be £428, or $2,140 per bed per annum; but if divided into wards of twenty-five patients each, the cost would be £231, or $1,155 per bed per annum; and if wards contained thirty-two beds the cost would be £220, or $1,100 per bed per annum. These figures have proportionately advanced in the forty-one years since her book was written. The architect should therefore endeavor, the factors of land space permitting, not only to arrange the wards according to sanitary and economic principles, but also to see to it that they are planned so as not to involve the management in avoidable expense in their administration. Architects sometimes fail to remember that they have it in their power to lessen or increase the annual expenditure.

In deciding upon the number of beds in each ward,

several factors enter into the proposition. First, floor space. Too much attention, as a rule, is given to cubic air space and too little to floor space. A sufficient amount of floor space is one of the most important considerations. A ward, when other standards are met, may be 28 feet wide, and for these reasons, viz., two standard hospital beds (6 feet 6 inches long) on opposite sides of a ward, with 2 feet between head of bed and the wall, will require 17 feet, and 11 feet has proved a suitable distance between the ends of beds for ordinary ward work; but if clinics with large numbers of students must be provided for, then more space is necessary. The modern tendency is against large student clinics in wards. This makes a total of 28 feet transverse linear measure from wall to wall. Economy in expenditure of force on the nursing staff must not be forgotten. Nurses always dislike to be assigned to circular wards, and naturally, as the excess of labor required for the same number of patients in a circular ward over that in an oblong ward makes an appreciable waste of their strength, without any better results for the patients.

The number of beds intended for a ward should somewhat influence the width, it being evident that a ward of six beds requires less width than one of twenty-eight. The distance between beds, from center to center, sometimes spoken of as "wall space," on the same side of a ward, is worth attention. The distances vary in different hospitals; some are as low as 6 feet and others as high as 9 feet 10 inches. The distance of 8 feet from center to center of bed is considered a fairly liberal standard for the average ward devoted to acute medical and surgical cases. But highly infectious cases, or offensive septic diseases, such as smallpox, empyæmia, etc., should be given 12 feet of wall space. Allowing the width of a ward to be 28 feet, with 8 feet from center to center of beds, gives a floor space of 224 feet for the two beds

opposite each other, or 112 feet for each bed; and this estimate is fully up to the average first-class ward.

In determining the height of a ward, several things are to be considered, — the amount of air available and used by the patient, the distribution of air as to direction and diffusion, the supplying of fresh air and the removal of vitiated air. This problem of ventilation was practically demonstrated by Dr. Edward Cowles, formerly superintendent of this hospital, in 1879, and the details of his demonstration may be found in the tenth annual report of the Massachusetts State Board of Health for the year 1879, page 231. These experiments proved that at or near the floor the movement of air was entirely lateral; at three feet, lateral and slightly upward; at five or six feet, upward and lateral; but at fourteen to fifteen feet the movement was entirely upward and not lateral at any point: indicating that all the air above fifteen feet was of no practical value to the patient, for want of diffusion. If, therefore, we place the height of a ward at fourteen feet six inches and multiply it by the one hundred and twelve feet floor space per bed, we obtain 1,624 cubic feet of air space per bed; and yet many hospitals of good repute have only 1,200 cubic feet per bed in wards for ordinary acute disease.

Having determined the proper floor space, the height of ward and the distance of beds from center to center, the legitimate length of the ward for twenty-eight beds is easily determined. Taking the beds from one to fourteen on each side, and allowing lateral space for each end bed, would make a total of one hundred and twelve feet as the desirable length for an oblong ward. These general dimensions may be compromised by cutting down the length from one hundred and twelve to ninety-eight feet; this slightly shortens the bed spaces and cubic contents, and yet does not depart too much from good standards. If any one rule must be maintained at the expense

of any other, the distance between bed centers should be the last to be disturbed.

Sunlight being one of the three important factors in good hospital construction, then properly designed windows should receive due attention. There should not be less than one square foot of glazed window to every seventy-two feet of cubic contents in each ward. Many of the older wards maintain this standard, with seven windows on each side of the ward or one window for every two beds. But a better arrangement is to have thirteen windows for fourteen beds; these obviously are smaller windows and are apt to be opposed by architects, partly because they lessen the architectural effect of the exterior and also increase the cost. The windows should have an overhead transom, opening inward from the top, and within one foot of the ceiling. The objection to overhead drafts is less than is generally supposed, when the nurses understand the meaning of windward and leeward. The sill of the windows should be low enough to permit the patient to easily look out of doors when in bed, about thirty inches from the floor being a good height. While a plentiful supply of sunlight obtains as a rule, there are times when it is desirable to temporarily exclude it, for instance in high temperatures in summer days or where the condition of patients' eyes forbids bright light. Blinds upon the outside are dirt catchers, are troublesome in high winds and not easily managed by women nurses. Inside blinds of all patterns afford needless extension of surface for the collection of dirt, and the ward maid in cleaning only reaches the lower part. I know of no more practical way than to install cheap roller shades of light color, reversing the top and bottom at the end of one year and destroying and renewing with new ones at the end of two years. A second dark shade should be furnished to windows from which bright light must be excluded as stated above.

In mild climates the French window with door sashes opening outward, or for the whole distance to floor opening upon a balcony, are every way desirable, but this is not usually practicable in the average urban hospital. Of course this does not apply to wards with delirious or untrusty patients. In this climate double sashes in rooms occupied by the sick are not only desirable but absolutely necessary. It is easily demonstrated that with the same temperature and velocity of wind, the difference between single and double sashes varies from four to seven degrees Fahrenheit. They also assist much in allowing direct-indirect ventilation to "flush" a ward without draughts.

The general interior construction of a hospital ward should compass two desirable features: First, as far as possible, the materials used should be non-absorbent and free from all extensions of surfaces and angles or ornamentations. The walls should be of plastic finish, and there are several desirable materials now in the market which are hard, non-absorbent and ultimately covered with oil paint or enamel flat finish. The perpendicular and horizontal lines of wall finish should be coved and the windows of the simplest finish. The doors should have pine cores and be veneered, so as to be without a line or moulding. Doors properly constructed of oak or ash, when well finished and varnished, have a beautiful appearance. They should be not less than three feet and four inches wide to easily admit litters, beds and wheeled chairs.

Materials for ward floors seem to be a stumbling-block in the way of fairly good results at reasonable cost. Encaustic tiles are probably, all things considered, the most desirable; they have the drawbacks, however, of being expensive at first cost, requiring frequent repair, and are hard on the nurses' feet. Oak floors are expensive at the outset and need the best of care to justify

their installation; maple and birch are not attractive in color or appearance, except selected birch, which is more or less expensive. Maple twists and curls at edges and shrinks lengthwise. There are new plastic floors in the market, ending with the inevitable "lith," which have many desirable qualities. They are not very expensive, have a fine "feel" under the feet, are not slippery, are noiseless and look well; but unfortunately, however laid, they soon crack. I know of no better material for ward floors at the present time, all things considered, than the best quality of clear rift, southern hard pine, strictly free from all defects, tongued and grooved, blind nailed, thoroughly kiln-dried and if possible laid in winter season. If properly put down, they are readily kept dressed by an inexpensive class of labor and look well enough for any grade of hospital ward. Hospital superintendents generally concede that the ideal floor still waits for an inventor.

Each ward of a large general hospital invariably requires special rooms adapted to the work of nursing. The room most in evidence day and night is the nurses' service room. It has different names in different hospitals and countries, such as duty room, service room, serving room, tea kitchen or scullery. By whatever name it is called, it should not be a scullery nor serve any purpose so that food cannot be decently served in it, which is its chief function. For a ward of thirty patients it should not be less than sixteen by sixteen feet, or two hundred and fifty-six square feet of floor in other proportions. Many architects of hospital plans, not knowing the daily ward routine, do not allow sufficient space. Often four or five nurses are distributing food on trays at the same time. To do this work properly, ample space must be allowed. The more complete service room should invariably have a terrazzo, tile, mosaic or non-absorbent floor of some kind; a dado five feet six inches high of

glazed tiles, the walls above and ceilings to be well covered with enamel paint.

The service room should contain a suitable gas stove of liberal size for making hot food and drinks, with ovens for keeping broths or dishes warm, and similar uses, at all hours of day or night, and a plate warmer is also a first-class requisite.

A portable refrigerator of liberal size for keeping milk, butter, fruit, beer, etc., must be at hand. Better still is a refrigerator built into some suitable corner of the service room, with walls of the same construction as the rest of the room. It should have at least four or five compartments, each lined with slate or thick milch glass with shelves of slate or removable galvanized iron mats. If the hospital has a refrigerating plant, it might be utilized here, promoting suitable cold and cleanliness, since ice in refrigerators tends to much moisture and uncleanliness.

Dumb waiters from the basement are necessary for quick conveyance of hot food. There should be preferably one for each story only, and some recently invented electrical dumb waiters work admirably, permitting both use and control by women nurses in each ward, instead of the heedless hand methods, which porters control in the basement. It is unnecessary to say that the car should be of metal, finished with enamel paint.

A porcelain sink for dish washing, of liberal size, with hot and cold water and attached drip boards, is indispensable. A flue twelve by sixteen inches is a desideratum for the drying of dishcloths, as they quickly become foul with organic matter in their ordinary use, and they often pollute the air of a service room when everything else is clean. Dishcloths dried on suitable racks, on a sunlit balcony, is a better way than all others. Shelves for ward crockery and cupboards for dishes for special patients and for nurses' use complete the list of

furnishings usually necessary. The things to be avoided in a service room are broom closets, numerous drawers, and, above all, the use of poultice dishes, fomentation cloths and the various utensils which come in contact with patients. Construction not only, but furnishing, is conspicuously important here, as it affects cleanliness.

Every well-arranged ward should be provided with a linen closet; a counter shelf on one side only of a narrow room for the folding of linen for ward and general use, with slatted shelves above, and cupboards, and a few drawers beneath. Here, also, are kept in labeled boxes, required articles for general use, but not necessarily bed linen. Pegs, hooks and similar fixtures are placed on the opposite wall for hanging splints, surgical cradles, crutches, etc., thus saving the nurses many steps in obtaining them from more distant places.

If it can be suitably arranged, a utility closet at the opposite end of the ward from the linen room, for keeping such articles as are used in bed-making, is desirable, and saves a nurse's strength.

Concerning the bathroom little need be said, except that the building materials should be non-absorbent, light in color, with white floor and walls, so as to easily show dirt. The tub, preferably of porcelain, should always be placed in the center of the floor, and accessible on all sides for the lifting of patients. A utility sink for nurses' use may be installed here, if room cannot be found elsewhere. Such work as cleansing rubber sheets, washing surgical dressing basins, making poultices, washing catheters and patients' toilet basins, and much other indispensable ward work obviously must not be done in the service room sink. But inevitably this work will be done there or in the bath tub, if a proper utility sink is not provided.

It is now generally understood that rooms for water-closets, urinals, etc., should have the same building

materials as the bathrooms. Some hospital superintendents are omitting urinals, which are so difficult to keep clean, and unless perfectly kept they become the most offensive fixture of the ward. Slop hoppers, suited to the use of bedpans and urinals, must be placed here. A ventilated closet, for dejections to be inspected by the doctors, is a hygienic and desirable feature.

Toilet basins for patients should not be combined with the bathroom nor with the water-closet, but in a room or alcove by themselves. Apparatus for hydrotherapy, X-ray or crematories for ward refuse should not be a part of the ward outfit, but are best arranged as a separate equipment or department, to which patients or materials may be taken from many wards. This plan is better for the patients, as well as for economy of administration.

A few other helpful things are necessary to make a perfected ward. A room for patients' clothes is required, with suitable metal stalls where the clothing may be hung up and exposed to the air, thus promoting cleanliness. Patients' clothing should never be done up in bundles nor placed in small "cages." This room is best when not heated, but requires a liberal fresh air inlet, and an outward "vent" that ventilates.

Hospitals vary in the method of installing what is comprehended by the words "medicine closet." Some keep the medicines in a conspicuous part of the open ward. The writer believes this to be a bad practice for reasons that cannot be elaborated here, and unfortunately sometimes it is entirely overlooked in the building plan. It should also not be placed in the service room. The best location is in the corridor, at or near the main entrance to the ward, the doors opening at the wall line, and constructed into some room space but accessible only from the corridor.

It should have a counter shelf of slate or dark marble with a fourteen-inch aluminum set bowl, with hot and

cold water, drainage and one electric light pendant. The shelves should be of slate or glass, both above and below the counter shelf. Such an arrangement is a help to cleanliness, promotes greater certainty in its work, and saves undue expenditure of effort on the part of the nurse. A special inside closet with alarm or other control is desirable, in which to seclude medicines marked "Poison."

In the larger teaching hospitals a special room for surgeons or physicians is considered necessary, in which patients may be examined or dressings changed. Indeed this is desirable in most wards, if the floor space permits. In small hospitals one or two isolating rooms for special cases should not be forgotten.

A caution is necessary in planning a ward lest, in taking the floor space required for all these special objects, the length of a ward becomes unwarrantably long, or that floor space that should be given to patients is cut down ; in either case the construction cost per bed would be somewhat larger than the *pro rata* which usually obtains. Not more than twenty per cent to twenty-five per cent should be allowed for rooms not devoted to patients' beds. This is one of the causes of increased cost of hospitals, but surely it is just these things that make hospitals of the best type, just as the up-to-date business office block is more costly but more efficient than the former styles.

The topics of stairways, fire escapes, elevators, roof airing courts, heating, ventilation, operating rooms and hospital administration, as well as ward furniture and equipment, are indirectly connected with the title of this paper ; a part is technical, but belongs to general building construction and requires careful consideration, but cannot be discussed here. From observation and the records of experience I have brought together briefly the essential features of a hospital unit, intended to secure the three great essentials for the cure of the sick, sunlight, fresh air and cleanliness.